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Application and Management of Information Technologies in Multimodal Transportation

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Abstract

In order to develop an integrated multimodal transportation, freight shippers and carriers, operators of multimodal transport in particular, must create and develop business strategies bringing together managerial, economic, technological and human resources. Additional investments are expensive for the companies, especially in the areas where quick orientation in the current situation is required. On the basis of diverse works of the authors, the paper analyses Information Technologies (IT) application multimodal transportations issues and perspectives, as well as provides the results of the research.

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Keywords: multimodal transport; delivery of goods; information technologies; management.

1. Introduction

Multimodal freight transportation connects several modes of transport and this leads to conclusion that enterprises are not financially capable of owning its own at least two different modes of transport. It is unlikely, that a single mode of transport would fulfill all requirements. Due to the large flow of information and diverse parameters, communication systems which would efficiently transfer unchanged information flow from one point to another is required. Information flows are required for material flow management. Human resources are important as it transform and manage material, financial and other capitals in organizations and create new value.

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Bystrom offers to classify information used to achieve specific goals into groups according to its activity role as following: professional field information about objects and events that are relevant to the task or problem: customers, suppliers, supply or sales operations, situation in the market.

The connection may be bidirectional. Mobile connection can be of the following types (Shiller 2001): radio data system, cellular, radial and others. In terms of voice recognition technologies it is worth to mention the system of Janus (Janus 2004) developed by the US and Germany scientists, which translates the spoken word into another language automatically.

Available IT resources such as technical equipment, software, data storage devices, communication networks provide services to the consumers, part of which is specific to some professional fields, and the other part is general one. (Laudon K. C., Laudon J. P. 2006). If the space for solution search is very large, the system distributes the space into segments, and does not deal with prospectless segments (Gavrilova 2000). Mobile devices can help shaping individual relationships with valued customers (Moeller 2003).

Aim of this article – to disclose the expression of IT applications in multimodal transportation. The article is based on theoretical material analysis supplemented with an empirical research – interview with Carriers ($N = 10$) and Questionnaire. Research was conducted from 2014-09 till 2014-12. The first part of Research is dedicated to methodological peculiarities of multimodal transportation organization and preparation to problem solution methodology. The Present Paper presents the second part of the Research directed at IT Application evaluation summarizing personal experience. Ten Managers from Logistics Enterprises and 256 Employees from Companies performing multimodal transportation took part in the Research. All Carriers' work experience is more than three years.

In order to ensure the efficient delivery of goods, Enterprises benefit from two or more modes of transport, i.e. perform multimodal transportation. According to A. Baublys, Multimodal transportation is the transportation of goods performed with at least two different modes of transport. Enterprises engaged in multimodal transportation should be more cooperative, have a good and modern reloading equipment and new integrated IT systems.

The central element in multimodal freight transportation is freight terminal. Taking into consideration interacting ranks of subsystem, transport terminal can be described in terms of incoming transport flows and infrastructure subsystems. Interaction of two or more transport modes in terminal reveal itself in five major forms – technical, technological, informational, legal, economical. Legal – regulations indicate duties, rights and responsibilities of all users of transport services; determine freight transportation conditions. Technical – ensures maximum coordinated arrangement of equipment in the terminal as well as functional connection of homogeneous equipment. Technological – Baublys (2007) states, that technological interaction is possible when the following requirements are fulfilled: Unity of technology and standardization of technological norms prevails; Coordinated schedules of different modes of transport and complex work planning in terminals. Economical – determines the final selection of an operation regime of different modes of transport. Expenditures related to productivity increase may be treated as investment since current expenditures are to compensate the earnings in the future (Bagdanavičius 2009). Informational – coordinates information on the basis of the submission form and time. Upon integration of general information systems it is therefore possible to investigate the situation of contemporary terminals and conditions of transport mode interaction. General information systems would enable to analyze transport flow formation regularities as well as improve methodology of transport planning calculations and future predictions. It is unlikely, that a single mode of transport would fulfill all requirements. Therefore, systems of several modes of transport are being developed, where shortcomings of one mode are compensated by the other. It is more comfortable to use such system services than order different modes of transport. (Baublys 2007). As pointed out by Bystrom (2004), business issues may be solved from the perspective of system process. There are distinguished three major system modelling objects in freight transportation decision-making process: input (order acceptance), process (from order filling till freight transportation), output (freight delivery). When it comes to order processing systems, the most popular are as follows: integrated logistics information system. According to Batarlienė (2011), this information system comprises data-bank and consumer terminal connections with other information systems – via internet to information systems of enterprises, ports and other structures of transport. Information on location and time of the arrival of transport mode provides an opportunity to prepare in advance the place for cargo in the terminal. Solution supply and decision-making support systems – solution supply systems – processing of data acquired from operation

systems; decision-making supply systems – facilitates the process of obtaining internal and external information, identify problems as well as analyze related situations (Batarlienė 2011).

2. Intelligent systems in multimodal transport sector

The role of transport in Lithuania's economy is exclusive – the generated share of GDP comprises 12.9%, despite the fact that only 5% of the country's working age population work in transport system. This sector encompass successfully operating major and minor enterprises that are the members of certain transport associations (Batarlienė 2014).

Due to the large flow of information and diverse parameters, communication systems which would efficiently transfer unchanged information flow from one point to another is required. Information flows are required for material flow management. According to Batarlienė and Jarašūnienė (2009), accurate, reliable and quick information provides an opportunity to accelerate the material flow – materials and goods to be delivered to addressee faster. Information systems applied in multimodal transportation are diverse and must perform certain functions: a) facilitate problem identification; b) enable to coordinate management equipment and perform logistics tasks. Multimodal transport chain comprises a unity of business entities engaged in cargo transportation. Members of this chain solve issues related to technical cargo transportation, exchange information on cargo to be transported and further process. The rapid advancement of technology, automation systems and data communications systems leads to improvement of intelligent transport systems (ITS) as well. ITS – is a general term referring to integrated connections, control and information processing technology application in transport system. The benefits it provides may save lives, time, money, energy and environment. ITS covers all branches of transport and considers all dynamically interacting elements of transport system, i.e. transport means, infrastructure, driver and consumer (Jarašūnienė 2008). ITS tools are based on information collection, processing, integration and presentation. One of the ITS is Intelligent travelling information systems which present data for the traveller providing prerequisites for route selection and transport modes. Accumulated data provide more accurate information for transport developers enabling transport planning optimization. Intelligent transport management systems (ITMS) may be determined by the following qualitative parameters: management scope, expedition, management algorithm, efficiency of data collection systems, diversity and usefulness of the provided information (Jarašūnienė 2008). Electronic Intelligent transport management system usually consists of: a) data collection subsystem; b) data transmission subsystem; c) management subsystem; d) separate subsystems of different hierarchical levels. Electronic Intelligent transport management systems comprise a number of technical means connected into general information processing complex. Minimal integrated system can store at least two systems that operate under general algorithms and connected interfaces, thus electronic intelligent transport management system is an integrated system. Information management systems – data processing systems are used for automatic data processing, whereas information management systems function as an operation management tool. No ordinary and casual operations, but operation management is central in these systems. Information management systems accumulate acquired information from diverse internal and external sources and appropriately transfers it to responsible parties. Such systems are capable of simple management of large information flows and generation of standard and non-standard reports. Each connected user must have an access to report that is generated according to his/her needs. Information transport systems are administrative, organizational, economic methodology designed for efficient operations, planning, management and accounting solutions in transportation. On the basis of the type of the activity can be divided into: Geographical information systems, Logistics information systems, Company's administrative management information systems. Generally, information management systems, with the main function of managing data-flow, data-bases, technological data processes can be reagrded as information systems. Logistics chain data model would exist in the development of information systems only when marketing, production and financial supply information projects are developed and implemented. Activities of transport and logistics enterprises are very receptive to information technologies. Enterprises constantly work with large amounts of information and it is neccessary to manage it quickly. Intelligent transport systems include extensive wireless and wired communications-based information and electronic control technologies. Integrated into transport system infrastructure, these technologies are capable of visualizing traffic flow, reduce traffic congestion, provide alternative routes, save time and money (Batarlienė 2011). Intelligent transport systems provide an opportunity to collect, compile and analyze data on

system operation during peak hours. Such accessible data increase traffic participants' possibilities to consider traffic accidents, weather conditions and other capacity-reducing factors. The main goal of intelligent transport system – is to collect information on traffic conditions and transport flows in the roads and provide it accurately via management systems. The gathered information is processed, integrated and thus provided for consumers. Operational requirements for Intelligent transport systems are often directed at Operation or Management Centers in major ITS service points: a) advanced traffic management systems: regional and local management centers; b) advanced travellers' information systems: multimodal transport travellers' information centers; c) advanced public transport systems: public transport management centers.

Organization of Multimodal transportation process requires data processing systems. Information transport systems involve information collection, storage and transmission. Since there is a large flow of information and different parametre, information and communication systems are required. In the process of multimodal transportation, information systems must meet the following criteria:

- System must be integral, i.e. connect all service positions of logistics;
- System multifunctionality and compatibility prevent partition of the language, text and video communication;
- System must be flexible, providing opportunities for solution implementation of central and individual computers;
- System must operate efficiently – provide economic benefits; however, data transmission should not be expensive;
- System must have an utmost portability, but directed at modern systems;
- System must ensure a high rate of transmission (Batarlienė 2011).

In order to make an efficient use of IT in multimodal transportation, one must plan cargo re-loading works in the terminal first. Enterprises, performing multimodal transportation solve technical issues of freight transportation and simultaneously provide information on cargo being transported. The main task of work organization in the terminal – optimization of each re-loading operation and interaction; efficient use of transport modes. Information systems applied in the terminal management control work-loads, facilitate smooth information provision regarding particular activities.

In accordance with the concept of automated management system, information system in the terminal must perform the following functions:

- Planning of the terminal and logistics centre applications;
- Planning of equipment applications;
- Planning of the loading works processing;
- Container management;
- Management of optimal automated equipment;
- Possibility to control and perform necessary changes;
- Receiving information and statistical data on equipment operations.

3. Results of the research on IT application expression in multimodal transportation

A large number of enterprises providing logistics services were launched due to increased competitiveness. In accordance with 2013 data acquired from Lithuanian Department of Statistics (Statistics Lithuania), road transport enterprises encompass the greater part (78%) in the sector providing transport services.

The number of transported cargo has increased by 10.7 percent. The major impact on this increase is to be determined by transportation from Lithuania and cargo transit. Other modes of transport – rail and marine transportation was detected to be of the lesser numbers (Žilinskas 2014). World's transport system has more than 100 million people (Jaržemskis et al. 2012).

When it comes to multimodal transportation, it is possible to analyze container transportation by different modes of transport. The cheapest way of container transportation is performed by rail and marine transport.

A method of a Questionnaire was selected for Research. Quantitative Research methods measure events and phenomenon in numbers and are objective and reliable. The Scope is determined by the means of Research methods, respondents answer the questions and the frequency of their responses and other statistical characteristics are

determined. Quantitative Research methods measure events and phenomenon in numbers and thus are objective and reliable. Respondents answer the questions and the frequency of their answers and other statistical characteristics are determined. It is therefore important to balance between briefness and reliability. The particular number of questions was selected in order to ascertain the respondents' opinion on IT application demand and service quality. The objective of the Questions – to acquire thorough knowledge and information on the phenomenon under investigation. A Questionnaire comprises a group of interelated questions.

The objective of IT Evaluation was implemented by the means of empirical investigation – a Questionnaire was given to respondents, selected from Lithuanian transport sector. 280 Questionnaires were sent to Respondents; 256 returned completed. The Questionnaite was primarily designed to ascertain the potential of IT in Lithuanian transport sector organizations while managing and organizing multimodal transportation. The question whether an enterprise has an integrated IT was answered positive by 100 percent of the respondents. Integarted IT systems proportionally distributed in accordance with the respondents' answers: 30 percent "Navisat" and 24 percent "Axapta", 16 percent "Būtent" and others.

The second block of questions was related to IT applications in Lithuanian transport sector organizations performing multimodal transportation. The fact that IT facilitates information transmission between terminals and departments was agreed by 100 percent of the respondents. However, 66 percent of the respondents replied 'no' and 34 percent selected 'I do not know' option while being asked whether an enterprise collects information on traffic conditions and traffic flows in the roads and thus provides unaltered information. Oddly enough, the same distribution of the percentages can be detected in response to the question: 'Are you willing to change the existing IT?' 66 percent of the answers were positive and 34 percent of the respondents replied 'I do not know'.

The third block of questions was related to the benefits and functions of IT in the management processes of an Enterprise. 100 percent of the respondents replied that joint information systems enable to analyze traffic formation better. In accordance with management system concept, information system performs certain functions in an enterprise, which are shown in the Fig.1.

The figure 1 suggest, that *'Planning of Equipment applications'* is well-regarded function which can not be said for *'container management'* function in Fig. 2.

As Fig. 2 indicates, *'Optimal automated Equipment Control'* and *'Information and Static data on Equipment'* were positively evaluated by 100 percent of the respondents, however *'Container Management'* was evaluated negatively by 100 percent of the respondents.

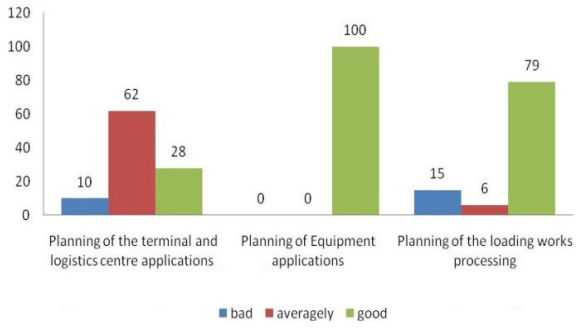

Fig. 1. Functions performed by Information Systems in an Enterprise (%).

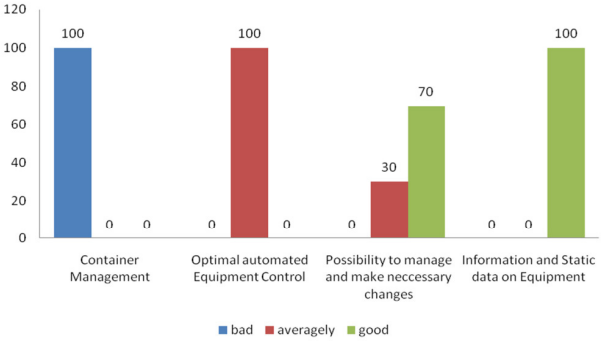

Fig. 2. Functions performed by Information Systems in an Enterprise (%).

As Fig. 3 shows, option *'System provides alternative routes'* was evaluated as *'bad'* by 72 percent of the respondents, where as *'System considers traffic and weather conditions'* was assessed as 'average' by 72 percent of the respondents. The question you have enough knowledge to manage IT technology contained in your company responses were 24% is sufficient for an average of 35% and 41% do not know and this means that knowledge is not enough for many workers and corporate executives should raise the competence of employees.

Fig. 4 shows, that 84 percent of the respondents claim, that freight transportation flows have increased, while 6 percent states, that they ‘do not know’.

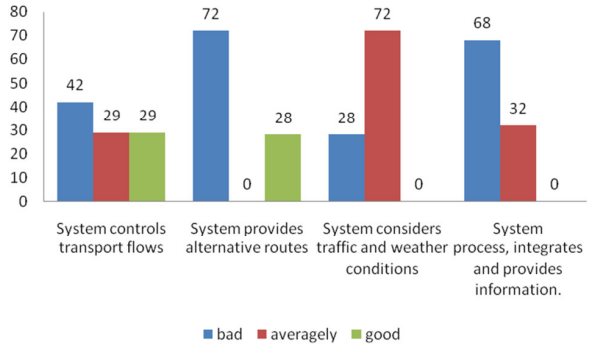

Fig. 3. Evaluation of information system operating processes in an enterprise (%).

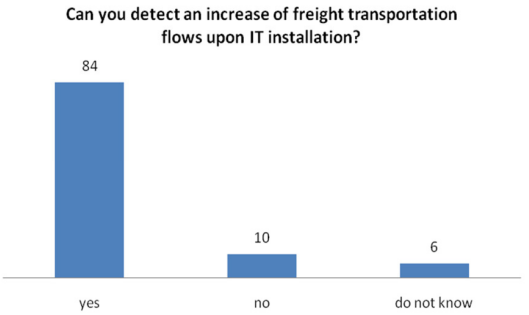

Fig. 4. Increase of Freight transportation flows upon IT installation.

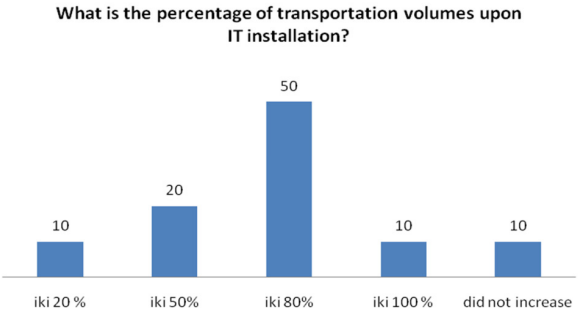

Fig. 5. Increase of transportation volumes by percentages.

As Fig. 5 indicates, 50 percent of the respondents claim, that transportation volumes have increased by up to 80%, however 10 percent state, that transportation volumes did not increase.

4. Conclusions

1. In accordance with empirical research findings regarding ‘Optimal automated Equipment Control’ and ‘Information and Static data on Equipment‘ were positively.
2. In accordance with empirical research findings regarding the in accordance with management system concept, information system performs certain functions in an enterprise, which respondents accept that ‘Planning of Equipment applications’ is well-regarded function.
3. In accordance with empirical research findings regarding the IT applications in multimodal transportation, it is therefore recommended to improve the work of the system on the gathered information on traffic conditions and traffic flows; unaltered information and container management.
4. In accordance with empirical research findings regarding the IT applications in multimodal transportation, it is therefore recommended to raise the competence of employees.
5. Professionals are highly advised to analyze all aspects of IT instillation planning process; Transport enterprises should be more open to innovations.

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